

1 **APPLICATION FOR PATENT**

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3 **TITLE: ROTO-ERECTOR FOR J-LAY PIPELAYING SYSTEM**

4 **RELATED APPLICATIONS**

5 None

6 **BACKGROUND OF THE INVENTION**

7 **1. FIELD OF THE INVENTION**

8 This invention relates generally to laying underwater pipelines in relatively deep
9 water using a J-Lay method from a floating vessel and, more particularly, to installing
10 underwater pipelines on the seabed and/or connecting the same to floating terminals at
11 the surface.

12 **2. DESCRIPTION OF THE RELATED ART**

13 Subsea pipelines have most often been laid on the ocean floor by connection of
14 welding on the deck of a barge, lowering off the back of the barge down a stinger or
15 curved guide, and then laying on the ocean floor. The curve down off the barge and
16 then reverse curve onto the ocean floor gives an "S" bend in the pipeline during the lay
17 process. The stinger allows the pipeline and its associated weight to be curved down
18 toward the ocean floor without kinking or damaging the pipeline. As water depths
19 become greater; the size, weight, and cost of the stinger become prohibitive.

20 In deeper water, it is advantageous to connect the pipeline near vertically and
21 lower it directly into the water, with a single bend at the ocean floor. This gives the
22 shape of a "J" for a system known as J-Laying pipe. The "J" cannot be vertical at the
23 top, but rather must have an angle with a horizontal component to be able to pull
24 horizontal tension on the pipeline as it is being laid onto the ocean floor. If it does not

1 have horizontal tension, it will buckle as it is laid on the ocean floor and be damaged
2 beyond use.

3 Sections of pipe are sequentially brought into the mast structure of a J-Lay
4 system and welded to the end of the pipeline depending from the J-Lay system. As
5 each section is welded in place, the pipeline is lowered by the length of the new pipe
6 section and the vessel moves forward a similar amount. In most cases the vessel will
7 move forward at a slow and continuous speed, whereas the pipeline itself is lowered in
8 a stepwise fashion.

9 A common requirement for J-Lay systems such as this is to bring the new
10 sections of pipe into the mast for welding. As the new pipe sections are normally stored
11 horizontally, they must be erected to a near vertical position. An erector arm can be
12 provided which will move the pipe about a pivot from horizontal to near vertical
13 positioning. A crane or multiple jib cranes can be used to lift the pipe from the deck
14 storage racks up to the gripping mechanisms on the top side of the erector arm.

15 A difficulty arises when the crane uses its cable to pick up a new pipe section it is
16 sensitive to weather conditions. In still water it will not be difficult to move the new pipe
17 section to the grippers on an erector. In marginal weather conditions, the motion of the
18 vessel can cause a swinging motion of the new pipe section, making it difficult and
19 potentially unsafe to try to land.

20 As the pipeline starts to swing, the operations become weather sensitive. It can
21 cause the operations of the vessel to be shut down for safety of operating personnel,
22 when productive operations could be carried on otherwise.

23 The present invention is directed to overcoming, or at least reducing the effects
24 of, one or more of the problems set forth above.

1 **SUMMARY OF THE INVENTION**

2 The object of this invention is to provide an erector for a J-Lay tower which will
3 provide a positive control of the motion of the new pipe section at all times.

4 A second object of this invention is to provide means for controlling the position
5 of the new pipe section in a way which will extend the weather window of operations.

6 Another object of this invention is to provide means to pick up a new section
7 below an erector arm, move it above the erector, and present it to the mast.

8 Other objects and advantages of the invention will become apparent upon
9 reading the following detailed description and upon referring to the drawings which
10 follow.

11 **BRIEF DESCRIPTION OF THE DRAWINGS**

12 Figure 1 illustrates the apparatus for assembling and deploying pipe string
13 underwater, mounted on the rear of a floating vessel and deploying a pipeline.

14 Figure 2 shows a more detailed perspective view of the apparatus.

15 Figure 3 illustrates the erector system of the embodiment in various angular
16 positions.

17 Figure 4 shows an end view of the erector of this invention with the grabber
18 deployed below the erector engaging a new section of pipe.

19 Figure 5 shows the grabber in the same angular position as is in figure no 4, with
20 the grabber retracted toward the main erector arm.

21 Figure 6 shows the erector rotated to the vertical position above the main erector
22 arm.

23 Figure 7 shows a side view of a portion of the erector showing the extension
24 mechanism.

1 While the invention is susceptible to various modifications and alternative forms,
2 specific embodiments thereof have been shown by way of example in the drawings and
3 are herein described in detail. It should be understood, however, that the description
4 herein of specific embodiments is not intended to limit the invention to the particular
5 forms disclosed, but on the contrary, the intention is to cover all modifications,
6 equivalents, and alternatives falling within the spirit and scope of the invention as
7 defined by the appended claims.

8 **DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS**

9 Illustrative embodiments of the invention are described below. In the interest of
10 clarity, not all features of an actual implementation are described in this specification. It
11 will of course be appreciated that in the development of any such actual embodiment,
12 numerous implementation-specific decisions must be made to achieve the developers'
13 specific goals, such as compliance with system-related and business-related
14 constraints, which will vary from one implementation to another. Moreover, it will be
15 appreciated that such a development effort, even if complex and time-consuming, would
16 be a routine undertaking for those of ordinary skill in the art having the benefit of this
17 disclosure.

18 Referring now to figure 1, the j-lay tower 10 is shown on a floating vessel 12 in a
19 body of water 14 with a pipeline 16 extending below the j-lay tower 10 around a bend 18
20 and onto the ocean floor 20. The j-lay tower 10 is shown with a mast 21 including a
21 lower section 22, a middle section 24, and an upper section 26; a working table 28; and
22 a skid 30. A new pipeline section 32 is shown on the erector 34. The erector can be
23 pivoted up to the mast to deliver the pipe either by being pushed up by hydraulic
24 cylinders or pulled up by a wire rope attached to the mast.

1 As can be noted, the tower is inclined at an angle convenient to the laying of the
2 pipeline. Jack assemblies 42 assist in the changing of the tower angle as required.
3 Stinger 44 provides internal rollers whose inner diameter provide a curvature to prevent
4 overbending of the pipeline. The preferred running style is with the tower perfectly
5 aligned to the pipeline, while using the angle gained around the curvature of the stinger
6 as a margin of error if unforeseen events occur.

7 Referring now to figure no. 2, a perspective view of the apparatus is shown with
8 the erector 34 shown partially raised toward the mast sections 22, 24, and 26. Main
9 cylinders 50, with cables 52 over drums 54 are used to lift the travelling table 56 to
10 power the system. Erector 34 is shown with main arm 60, pivot axle 62, and grabbers
11 64 and 66. Grabbers 64 and 66 are shown in a position above erector main arm 60. As
12 will be seen later, grabbers 64 and 66 and be rotated about the pivot axle 62 to a
13 position below main erector arm 60 for picking up pipe.

14 Referring now to figure no. 3, the erector 34 with new pipeline section 32 is
15 shown in the horizontal position at 70, raised 45 degrees at 72, and engaging the
16 vertical mast at 74. It is pivoted about axles at 76. An additional new pipe section 80 is
17 shown on pipe racks 82 and 84 waiting on being picked up by grabbers 64 and 66 when
18 the grabbers 64 and 66 are rotated down about the pivot axle 62.

19 Referring now to figure no. 4, a partial view of figure no. 3 is shown taken along
20 lines "4-4". Grabber 64 is shown pivoted down about pivot axle 62 and engaging new
21 pipe section 80. Additional new pipe sections are shown at 90, restrained by a stop arm
22 at 92. Cylinders 100 and 102 provide the power to rotate the grabber by pushing on
23 arm 104 which is attached to pivot axle 62. Scissor mechanism 106 is used to extend
24 and retract the grabber 64, as will be described later.

1 Referring now to figure no. 5, the scissor mechanism 106 has been retracted to
2 allow the grabber to be rotated clockwise about pivot axle 62 to move new pipe section
3 80 above main erector arm 60.

4 Referring now to figure no. 6, grabber has been rotated to the upper position,
5 ready for engagement with the mast. In addition to being positioned for engagement
6 with the mast, the scissor mechanism can be extended to give adjustment flexibility to
7 the alignment of the new pipe section in the mast.

8 Referring now to figure no. 7, a partial view of figure no. 6 is shown which is
9 taken along lines "7-7". Brackets 110 and 112 are attached to pivot axle 62 with arms
10 114 and 116 attached. Collars 120 and 122 are slidably mounted around the pivot axle
11 62 with arms 124 and 126. Arms 124 and 126 are interconnected to arms 114 and 116.
12 When cylinders 130 and 132 move collars 120 and 122 to the right or to the left, pinned
13 connections 134 and 136 move vertically away from the pivot axle 62. Bar 138
14 interconnects grabbers 64 and 66 so that they remain in a fixed relative position. In this
15 way a horizontal stroking of cylinders 130 and 132 provide for vertical extension and
16 retraction of grabbers 64 and 66.

17 By this combination of extension and rotation, the grabbers can engage a new
18 pipe section below the main erector arm, raise it to a position above the main erector
19 arm and extend it into a position of matching the centerline of the mast after the erector
20 has been appropriately raised.

21 The particular embodiments disclosed above are illustrative only, as the invention
22 may be modified and practiced in different but equivalent manners apparent to those
23 skilled in the art having the benefit of the teachings herein. Furthermore, no limitations
24 are intended to the details of construction or design herein shown, other than as

1 described in the claims below. It is therefore evident that the particular embodiments
2 disclosed above may be altered or modified and all such variations are considered
3 within the scope and spirit of the invention. Accordingly, the protection sought herein is
4 as set forth in the claims below.

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